Centre de Calcul de l'Institut National de Physique Nucléaire et de Physique des Particules

Large Synoptic Survey Telescope

evaluation of Rucio

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CCIN2P3 cnrs

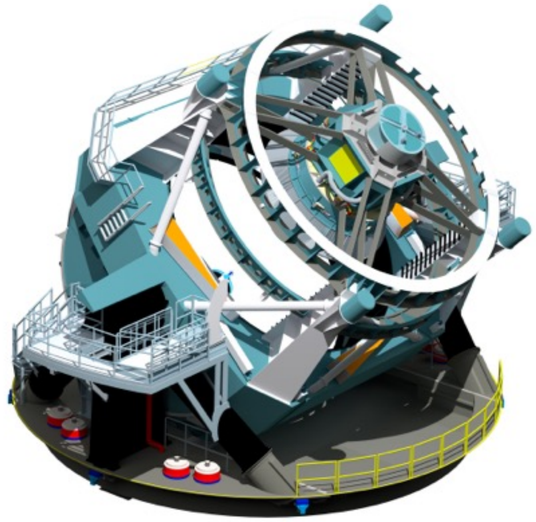
2nd Rucio Workshop, Oslo, March 1st, 2019

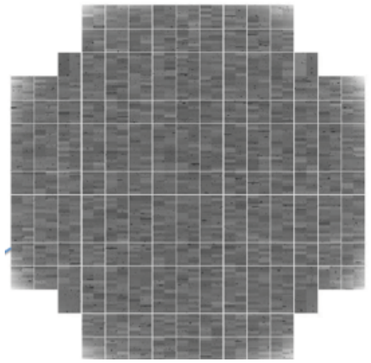
CONTENTS

- LSST overview
- LSST data processing
- IN2P3 contributions to LSST
- Evaluation of Rucio

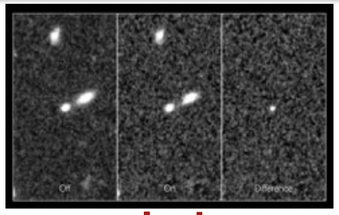
LSST OVERVIEW

LARGE SYNOPTIC SURVEY TELESCOPE

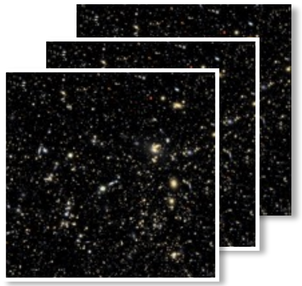




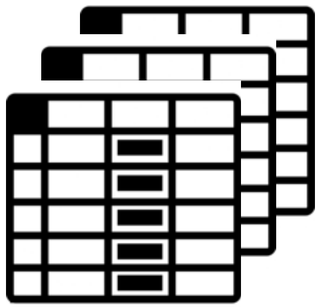
raw images



alerts



calibrated exposures
co-added images



astronomical catalog

science
collaborations

LSST aims to deliver a catalog of 20 billion galaxies and 17 billion stars with their associated physical properties

LSST OVERVIEW (CONT.)

- Principle of operations

  *90% of the observing time of the telescope devoted to a **deep-wide-fast survey***

  one complete visit of the southern hemisphere sky every 3-4 nights**, from 2022 for **10 years

  43% of the celestial sphere will be covered by this survey

  each patch of the sky to be visited about 1000 times

- Science themes

  *determining the nature of **dark energy** and **dark matter***

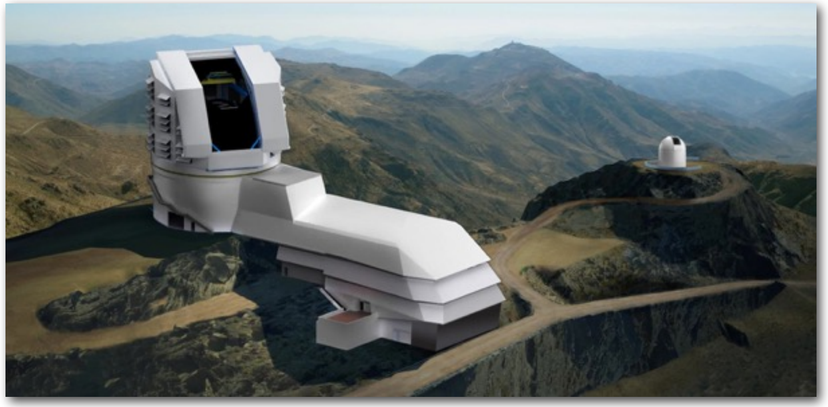
  *taking an inventory of the **solar system***

  *exploring the **transient** optical sky*

  *mapping the structure and evolution of the **Milky Way***

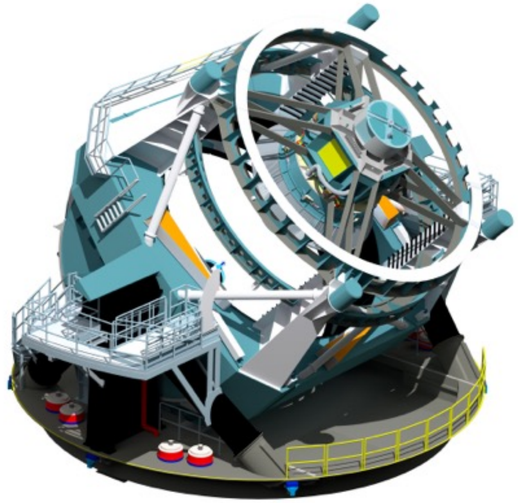
LSST OVERVIEW

OBSERVATORY



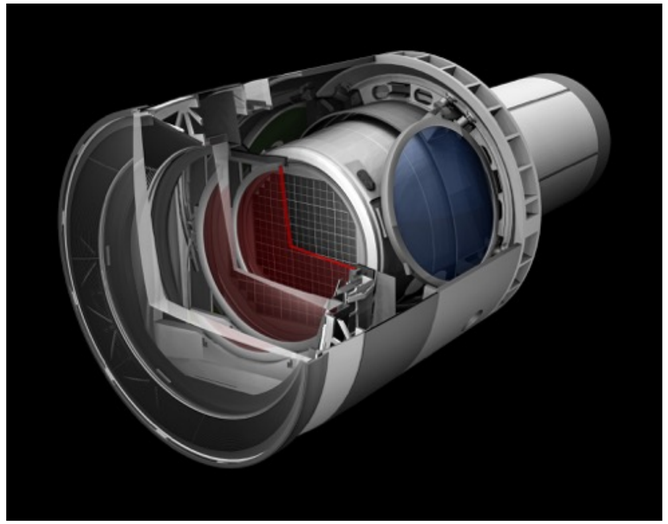
south hemisphere | 2647m a.s.l. | stable air | clear sky | dark nights | good infrastructure

TELESCOPE



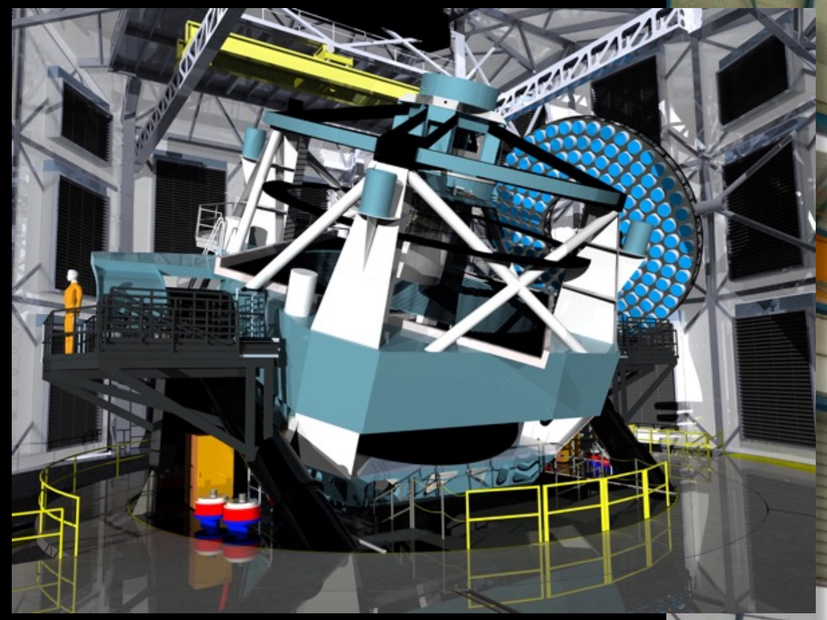
main mirror ⌀ 8.4 m (effective aperture 6.5 m) | large aperture: f/1.234 | wide field of view | compact | 350 ton | to be repositioned about 3M times over 10 years of operations

CAMERA



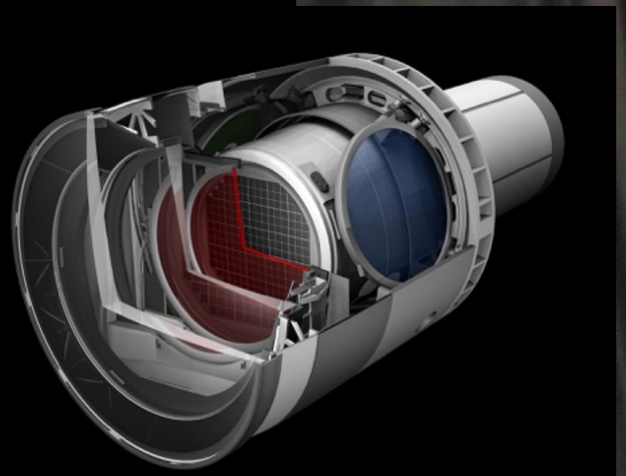
3.2 G pixels | ⌀ 1.65 m | 3.7 m long | 3 ton | 3 lenses | 3.5° field of view | 9.6 deg^2 | 6 filters ugrizy | 320–1050 nm | focal plane and electronics in cryostat at 173K

Sources: LSST, Gianluca Lombardi (2018-08)



ROTATION: 10 deg/s
3.5° SLEW-SETTLE: 5 s

Sources: LSST, Asturfeito (2018-03)



LSST DATA PROCESSING

Data Acquisition

- Raw data

  7.2 GB per image

  2000 science images + 450 calibration images per night

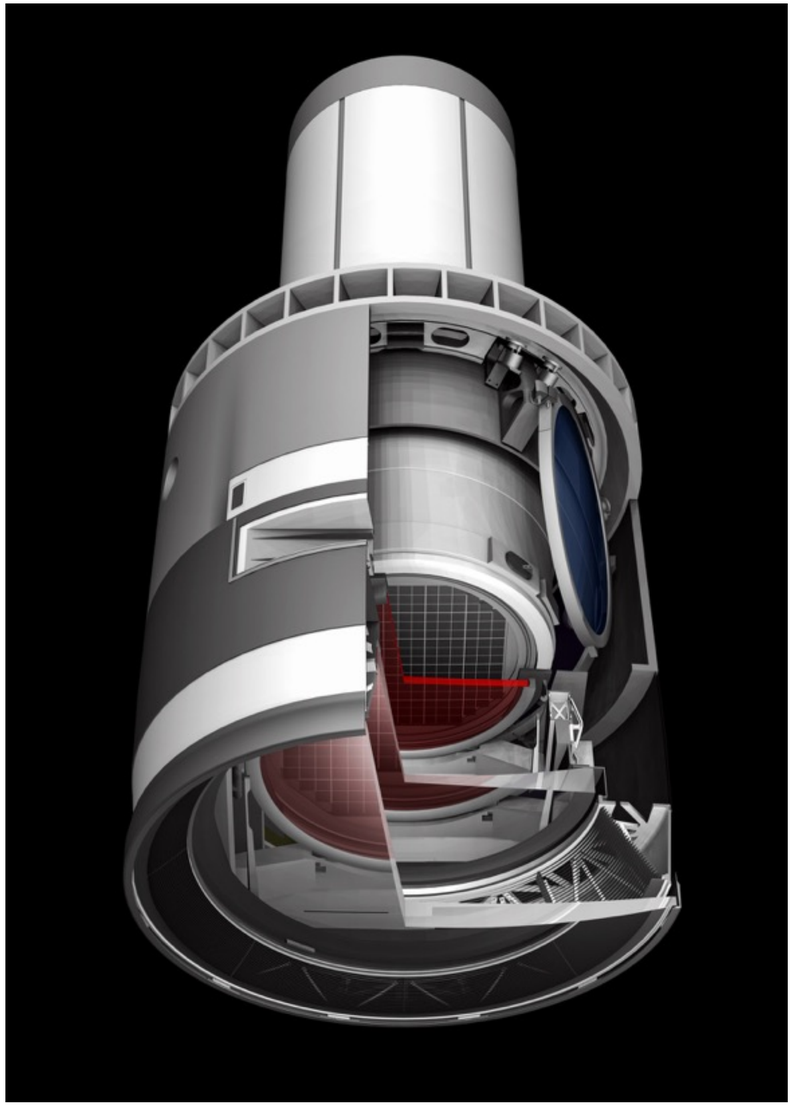
  300 nights per year, ~20 TB per night ⇒ ~6 PB per year

- Aggregated data over 10 years of operations*, including derived data

  images: ~6M exposures, 515 PB

  final catalog database: 15 PB

  ** source: LSST key numbers*



Source: LSST

LSST DATA MANAGEMENT SUBSYSTEM

- Archival

  *to **record**, **transport** and permanently **store raw data** issued by camera*

- Processing

  *to **detect transients** and **emit alerts** within 60 seconds after observation*

  *once per year, to **produce a data release**: a **self-consistent, immutable dataset**, composed of **processed data since the beginning of the survey***

  *to **develop the software** necessary for processing the data: image processing algorithms (calibration, point spread function, co-addition of images, characterization of objects, processing pipelines, …), catalogue database, middleware (workload management, orchestration, …), data transfer, etc.*

- Publication

  *to **deliver the reduced data** (images + catalogs)*

  to facilitate custom data reduction and individual data analysis

LSST DATA MANAGEMENT CONTRIBUTORS

Princeton University

UNIVERSITY of WASHINGTON

National Optical Astronomy Observatory

SLAC

SLAC National Accelerator Laboratory
Stanford University

Infrared Processing and Analysis Center
California Institute of Technology

DATA RELEASE PROCESSING CENTRES

National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign

CNRS / IN2P3 computing center

Large Synoptic Survey Telescope

LSST Operations: Sites & Data Flows

HQ Site

Science Operations
Observatory Management
Education & Public Outreach

Base Site

Base Center
Long-term storage (copy 1)

Data Access Center
Data Access & User Services

French Site

Satellite Processing Center
Data Release Production
Long-term Storage (copy 3)

Archive Site

Archive Center
Alert Production
Data Release Production
Calibration Products Production
EPO Infrastructure
Long-term Storage (copy 2)

Data Access Center
Data Access and User Services

Summit Site

Telescope & Camera
Data Acquisition
Crosstalk Correction

Source: LSST

LSST AT IN2P3

- IN2P3 contributes to the construction of the LSST camera

  CCD electronics, filter carousel, filter autochanger and manual loader (design, construction, command and control software)

- IN2P3 is also preparing its contribution to **offline data processing** during both the commissioning and operations phases

  equipment and labor at IN2P3 computing center

LSST AT CC-IN2P3

- Main roles

  satellite data release production *under NCSA leadership*

  CC-IN2P3 to ***process 50% of the raw data***

  both NCSA and CC-IN2P3 will exchange and validate the data produced by the other party

  each site to ***host an entire copy of both raw and reduced data****, i.e. the products of the annual data release processing (images and catalog)*

- We are evaluating Rucio for managing data distribution among LSST data release processing sites

  our goal is to inform the decision that will ultimately be made by NCSA

DATA RELEASE PROCESSING

- Data release processing pipelines
  - *set of stages for extracting information from images: detect astrophysical objects and their physical properties*
  - *produce the data to populate the astronomical catalog*
  - *C++ and Python 3*
- File size in the range 50 - 100 MB
  - *1 file per CCD (there are 189 CCDs in the focal plane)*
  - *currently FITS format*
  - *~10B files aggregated over the 10 years of operations (raw + derived)*
- High-level I/O abstraction layer designed to make life easier for scientists
  - *currently requires POSIX API and needs control the file namespace*
  - *ongoing work to improve this situation to include requirements for bulk processing*
- During annual release processing, only a few production accounts interact with the file catalog
  - *however, access to previous years' data releases covered by embargo only accessible by individuals with data rights*

Evaluation of Rucio

RUCIO

Rucio Evaluation at CC-IN2P3

March 01, 2019

Bastien Gounon

CCIN2P3

cnrs

Contents

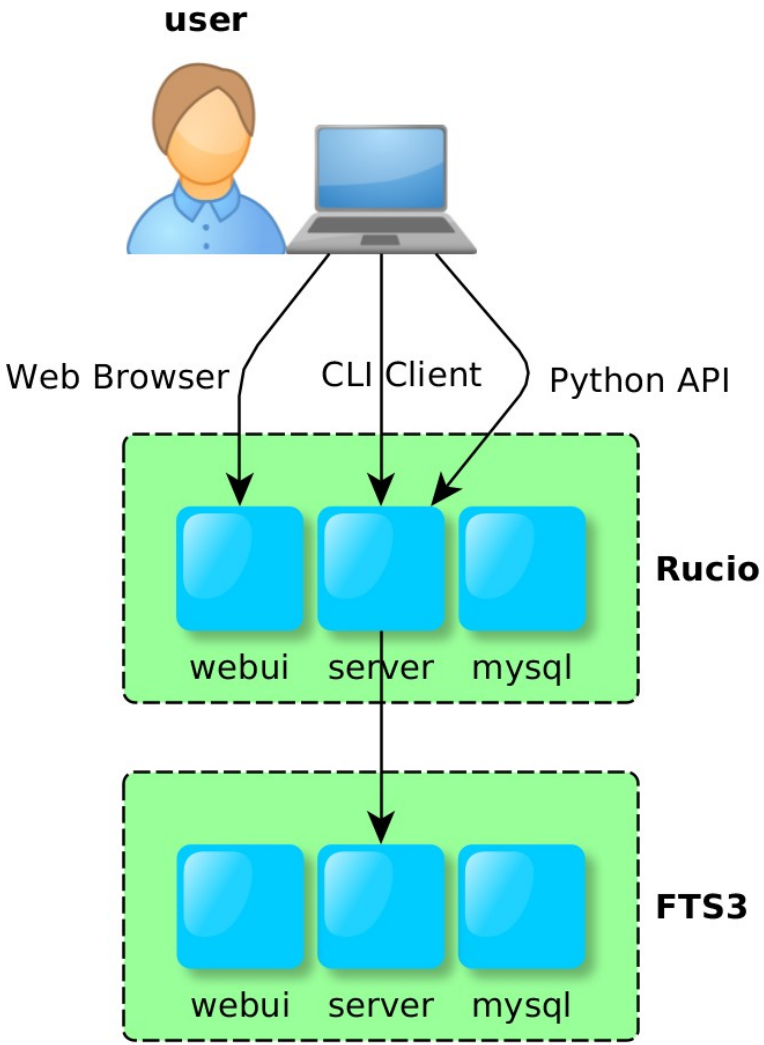
- Goals
- Tests
- Observations and discussion
- What we would like to see
- Conclusion

Goals

- Familiarize with Rucio and FTS
- Understand their assets and features
- Understand how they could fit LSST usecases, and vice-versa
  - Data replication
  - Dataset management

Tests - Our environment

- Deployed with Docker
- Multiple communication interfaces
  - Web UI
  - CLI client
  - Python API
- Getting started
  - prerequisite : a working FTS instance
  - edit rucio.cfg and alembic.ini
  - setup your certificates
  - setup accounts & RSEs with a Python script
  - start daemons

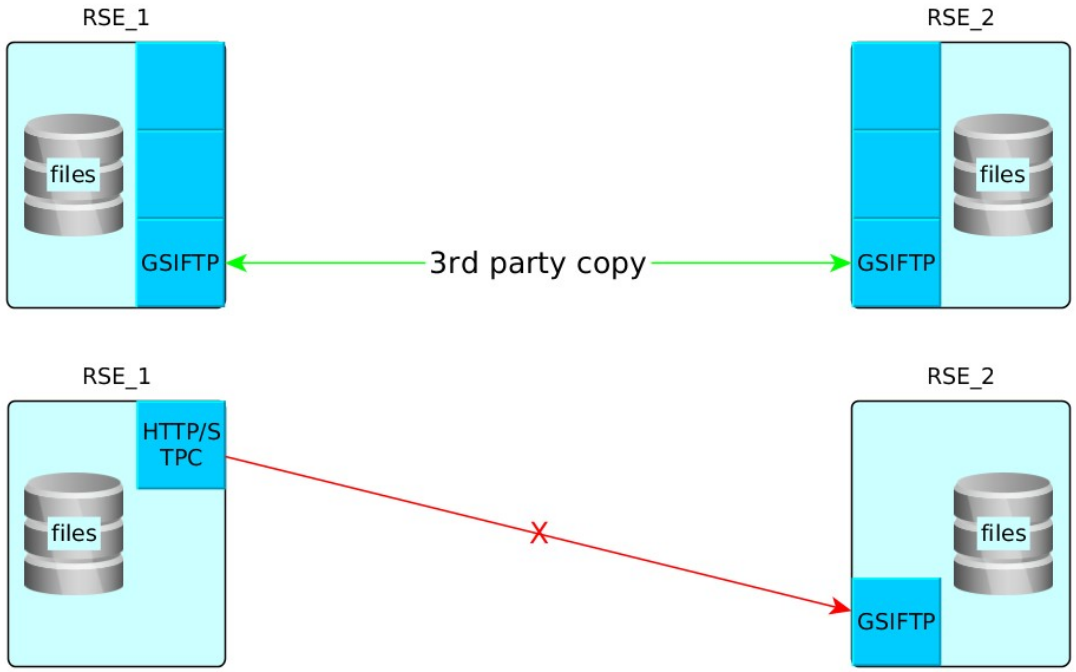


Tests

- Configure several RSEs with different protocols
- Try typical workflow and DID management
  - upload files
  - replicate datasets using rules
  - attach files to existing datasets
  - download datasets
- LFN2PFN algorithms
  - identity (scope:file => {URL}/scope/file)
  - hash (scope:file => {URL}/scope/8a/01/file)
- Authentication methods and account switching

Observations and discussion

- Inter-protocol replication ?



Observations and discussion

- Retrying failed replicas
  - some errors will trigger automatic requeuing of the file
  - while some others may require manual intervention (e.g. create a new rule or update the database)
- Finding usage examples and sample configuration files is not easy
- … references to CERN servers in the demo config !

More features we would like to see

- Register pre-existing files ?
- Customized folder structure ?
  - replicating the namespace from a single top directory
- External authentication support ?
- Ability to rely on a different transfer scheduler/library ?

Conclusion

- Things look promising !
  - FTS has proven its efficiency for data transfers, either standalone or paired with Rucio
  - Rucio makes data management easier in a multi-site context, and tasks can be highly automated
  - These features could prove beneficial to LSST
- Evaluation is still ongoing
  - discussions with the LSST DM team at NCSA are taking place

Questions ?

BACKUP SLIDES

IN2P3

A DISTRIBUTED LABORATORY

in2p3.fr

2500 researchers, engineers and technicians

700 post-docs and PhD students

25 laboratories and research platforms in France, 16 international laboratories

IN2P3 COMPUTING CENTER

- CC-IN2P3

  84 people, 80 FTE, 80% permanent positions

  ~15 M€ overall annual budget

  scientific data center, high throughput computing

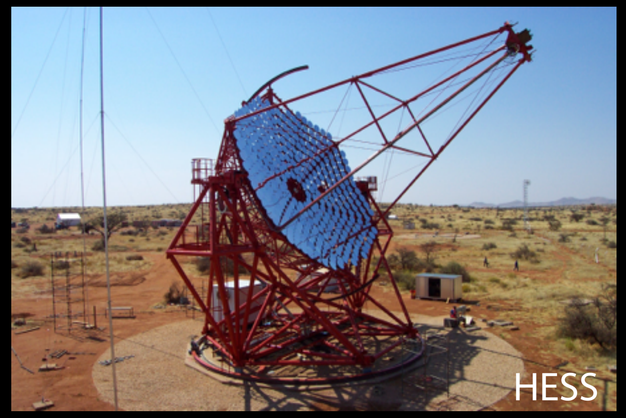
  well connected to national and international networks

- Shared computing facility supporting the institute's research program

  ~70 projects in high energy physics, nuclear physics and astroparticle physics

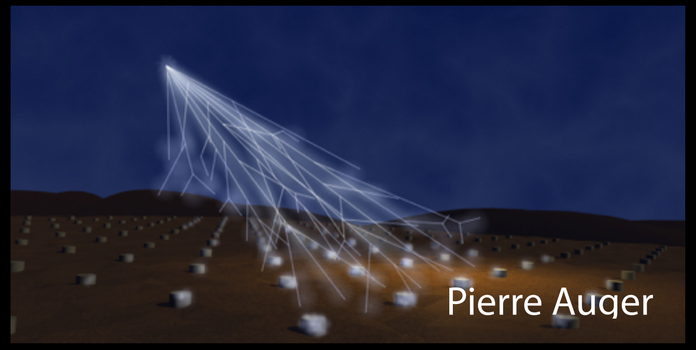
- Operations: 24x7

  unattended during nights and weekends



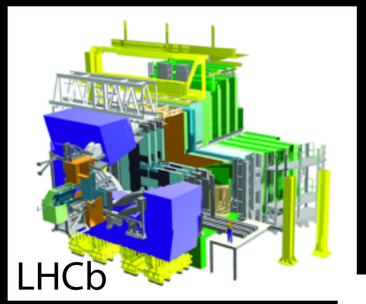
Planck

Fermi



AMS

SuperNova Legacy Survey



LHC @ CERN